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ON THE GENUS *SYNAPTA*. BY S. P. WOODWARD AND LUCAS
BARRETT. (COMMUNICATED BY J. S. GASKOIN, ESQ.)

(Radiata, Pl. XIV.)

The marine animals allied to the Sea Cucumbers, forming the genus *Synapta*, possess a peculiar interest for that large class of persons who study Natural History with the microscope, because they afford the miniature *Anchors*, of which a hundred may be shown in the field of the "inch object-glass," and thousands sometimes exist in the space of a square inch—each elegant in form and perfectly finished, and articulated to an anchor-plate whose pattern (as well as that of the anchor itself) is characteristic of the species to which it belongs.

Curiously enough, these anchors were unknown to all the earlier writers, and most of the moderns. Forskål, who had the merit of describing two species of *Synapta* so long ago as 1775, remarked that they "adhered to the finger by glutinous papillæ invisible to the eye." O. F. Müller called the Northern species *Holothuria in-hærens* for the same reason. And Eschscholtz, who met with several species at Tahiti and on the coast of Russian America, concluded that they ought "to form a class apart, not having tubular feet, but adhering, by means of their sharp skin, to extraneous objects, on which account they might be called *Synapta* *."

Only five years ago (in 1853) Mr. Cocks of Falmouth described two British species, and gave a magnified figure of the skin without seeing the anchors. And still more recently Mr. Gosse was unable to find them, even with the aid of a microscope †. However, they are present in all the examples that have come under our notice, and they can always be seen with a common pocket lens. Indeed the larger anchors of *Synapta digitata* are nearly half a line in length, and visible to the unassisted eye.

Jæger says that all the anchors of his *Synapta Beselii* are $\frac{1}{3}$ rd of a line in length, and can be seen without a glass. This great *Synapta*

* Appendix to Kotzebue's Second Voyage, 8vo, Lond. 1830, p. 338. Van der Hoeven makes Eschscholtz say the *Synapta* adheres "by means of small hooklets;" but this expression (der sie überall wie Kletten anhängen) is employed in the introductory paragraph. In the special description of *Synapta* he only speaks of "small roughnesses (Rauhigkeiten) invisible to the naked eye." And he describes *Chiridota verrucosa* as, "corpore unicoque verrucis rubris adhærentibus obdito."—Zool. Atlas, fol. Berlin, 1829.

† Aquarium, p. 243.

of the Celebes is a yard long, and called a "sea-serpent" by the natives! *

Two other large species, described by Lesson, were said to create a burning sensation when handled; but it is not clear whether this was caused by the anchors, or by urticating organs, like those of the *Actinia* and *Æolis*. No such phenomenon could be detected by Quatrefages or other observers who have handled the smaller *Synapta* when alive.

The anatomy of these creatures appears to have been first investigated by Leuckhart †, who examined the *Synapta vittata* of Forskål, and ascertained that it had no internal respiratory organs like the *Holothuria*.

Anchors and plates attributed to this species, which comes from the shores of the Red Sea, near Suez, are to be found in the cabinet of every microscopic observer. The slides are prepared in Paris, and extensively re-manufactured in this country. The anchor-flukes are plain and simple, and the articular end of the shank is deeply subdivided. The plates are furnished with a raised arch at the smaller end, forming a sort of cavity for the reception of the anchor-stock. They are ~~exactly like those~~ figured in Müller's article, "Über den Bau der Echinodermen" (Berlin Trans. 1854, t. 6. f. 17), ~~under the name of *S. serpentina*.~~ There is a woodcut of them in Carpenter's work on the Microscope; and figures are also given in the Micrographic Dictionary. Mr. Wm. Griesbach has a *slide* with the miliary plates, which are oval and granular, very numerous, and all alike.

Prof. Forbes was unacquainted with the anchors of the British *Synapta*, and Dr. Carpenter in his last work (1857) says it is not known whether they have anchors, or wheels like *Chiridota*.

We have obtained evidence of both the European *Synapta* from several British localities; and as the published notices are scattered in many works, we propose to give some account of them, with figures of their spicula, and also to describe a new species from China.

1. SYNAPTA DIGITATA (HOLOTHURIA), Montagu. (Pl. XIV. figs. 1-17.)

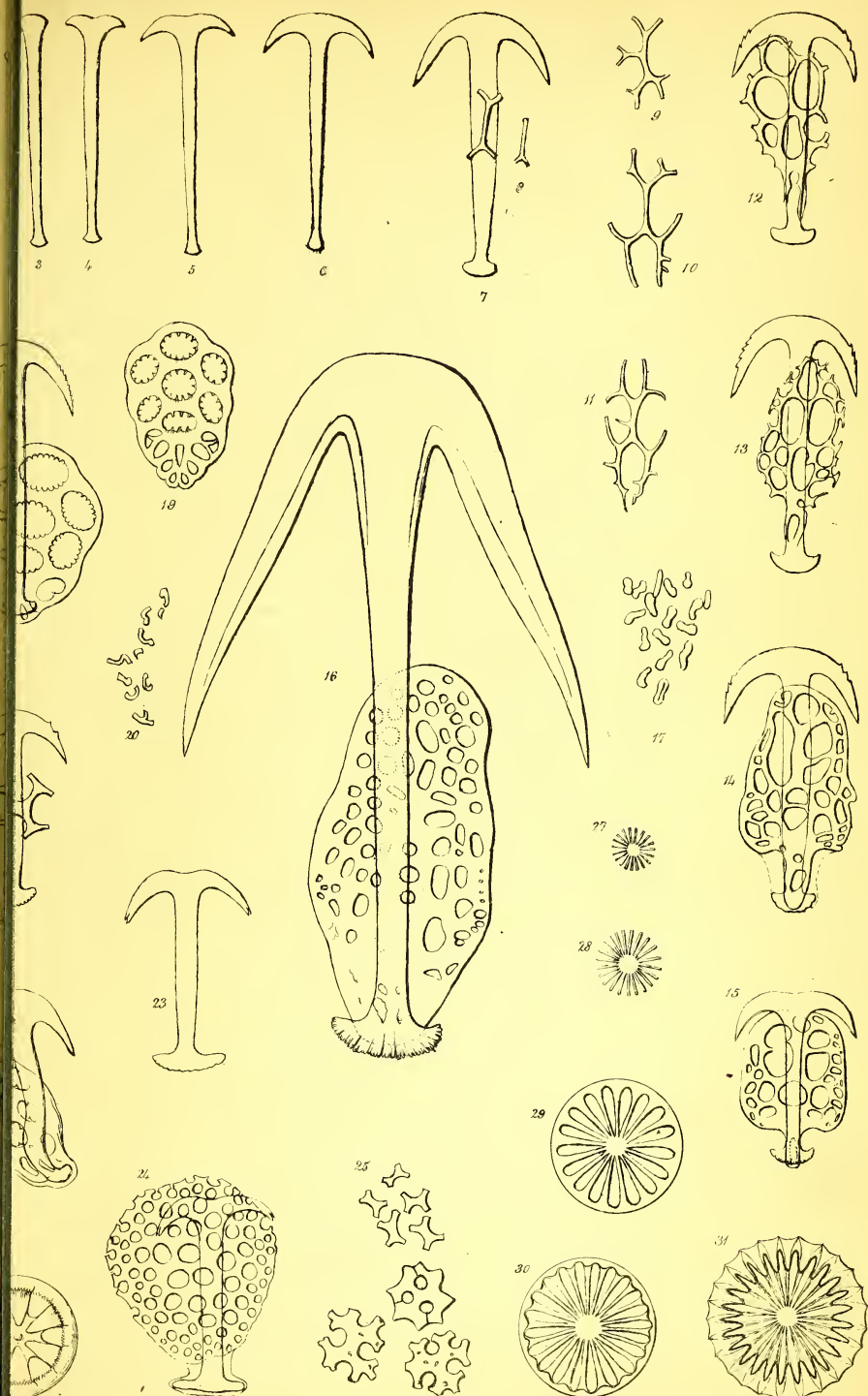
The earliest account of this species appears to have been given by Montagu ‡, who discovered it on the coast of Devonshire, and correctly observed its affinity with the *Holothuria inhærens* of the Zoologia Danica, but pointed out its characteristic difference by the epithet "digitata." It has four fingers to each of the twelve tentacles, and a minute thumb which has been overlooked by all observers except J. Müller. It was again found, prior to 1818, by Cranch (the Naturalist to the Congo Expedition), whose specimens are preserved in the British Museum §. In 1844 Mr. Joshua Alder discovered it on the west coast of Scotland, the most northern locality yet known. He says in a letter:—"I dredged the true *digi-*

* Dissertatio de Holothuriis, 4to. Turic. 1833.

† Isis, 1831.

‡ Linn. Trans. xi. p. 22. t. 4. f. 6.

§ Gray, Catalogue of British Radiata, p. 12.

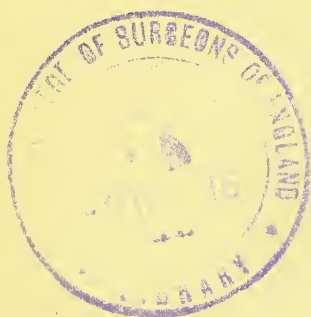


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Spicula of *Synapta* & *Chiridota*.

1-17 *Synapta digitata*. 18-22 *Synapta inhaerens*. 23-25 *S. bidentata*.
26 *Chiridota laevis*. 27-31 *Mynotrochus Rinkii*.



tata of Montagu in Rothsay Bay in 1844. At that time I could have got any number of specimens, though it was confined pretty nearly to one spot in shallow water. They broke themselves up so that it was impossible to keep them entire; I, however, made a drawing of one at the time, which I now send for your inspection." Mr. Alder further states that he had received specimens from Mr. Barlee, dredged in Birterbuy Bay and at the Arran Isles, on the west coast of Ireland.

In 1845 Mr. Alder again met with this species in Torbay; and in January 1854 the Rev. Charles Kingsley "collected many living specimens on the beach, near Torquay, washed ashore after a heavy gale."

In the 'Contributions to the Fauna of Falmouth' for 1853, by Mr. W. P. Cocks, this *Synapta* is figured and described, but not very minutely. "The specimens procured measured from $2\frac{1}{2}$ to $4\frac{1}{2}$ inches in length, and about $\frac{1}{4}$ inch in diameter. Found in the blue mud and sand, Helford; plentiful in particular localities; Falmouth, very rare."

The *Synapta digitata* ranges southward to the Mediterranean, and seems to be very common on the shores of the Adriatic near Trieste, since J. Müller speaks of finding the "molluskigerous sacs" in upwards of 70 individuals*. By the kindness of Dr. Hartmann of Berlin, we have received examples from the same locality. It was not found by Prof. Edward Forbes in the Ægean; the specimens distributed by him were taken by Mr. MacAndrew in Vigo Bay, on the north-east coast of Spain, in the year 1849. Last year (1857) we accompanied Mr. MacAndrew in a second dredging excursion to the same coast, and obtained numerous examples of the *Synapta* in 10-fathom water, a few miles below the town of Vigo; they had been previously found in shallow water, on the quarantine ground, about twelve miles higher up the bay. The specimens were small, none exceeding 6 inches in length and $\frac{1}{4}$ inch in diameter. In colour they were dull purplish red, slightly darker in front and on the back, and marked with five pale bands, indicating the longitudinal muscles which answer to the lines of suckers (or *ambulacra*) of the other *Echinodermata*. The skin was also mottled with minute red spots, produced by epidermal papillæ. We preserved every specimen we could find, hoping to detect the "molluskigerous sacs" in some new phase of their development; but in this we were entirely disappointed. The intestines of the creature were filled with inorganic mud, in which we detected an occasional Diatom or Rhizopod, but nothing more. When placed in basins of sea-water, they showed their tentacles freely, and most of them remained expanded when preserved in spirit. They were very sluggish, and did not evince much disposition to vomit their interiors or to break up into fragments. We readily detected them in the dredge, even when obscured

* Ueber S. DIGITATA und über die Erzeugung von Schnecken in Holothuriën. 4to. Berlin, 1852.

with mud, by their clinging to the fingers, as described by Eschscholtz.

In some examples the *anchors* are very few, and ranged in a double line along the muscular bands. They vary from about twenty-five in the field of the inch object-glass to three times that number. Their length averages about the $\frac{1}{100}$ th of an inch. The anchor-flukes are sometimes plain, and sometimes barbed with three to five serrations (figs. 6-16). The *anchor-plates* are oval and leaf-shaped, having a process (or stalk) at the end to which the anchor is articulated; the disk is perforated by four large simple holes surrounded by an irregular series of smaller openings; the articular process has a slit like the eye of a needle (fig. 15). In the northern specimens these plates are rounded and rather "obcordate," but in those from the southern locality they are longer, less regular, and somewhat contracted in the middle; the perforations also are larger in proportion, and more angular.

Some specimens possess a few great anchors, four times as long as the rest, and with large flukes, lying with great regularity in the interspace of the muscular bands; their plates are correspondingly large, and irregular in outline (fig. 16).

All the anchors are fixed transversely to the *length* of the animal, some being turned one way and some the other.

Besides these, the skin contains innumerable smaller particles, or *miliary plates*, which are especially crowded over the muscular bands. They are oblong, or hour-glass shaped, and about $\frac{1}{4}$ th to $\frac{1}{8}$ th the length of the anchor-plates, or from $\frac{1}{1000}$ th to $\frac{1}{500}$ th of an inch long (fig. 17).

By far the greater number of the anchors are imbedded in the skin; only a few rise above the surface or swing freely on their pivots. They are developed beneath the epidermis, become liberated by the wearing of the surface, and are themselves broken by use and worn away and replaced by others. The anchors are developed before the anchor-plates. First, we find a simple, slender spiculum (fig. 1); then another (fig. 2), longer and expanded at one end; those only which have attained their full length begin to develop flukes (figs. 4, 5); and it is not until the anchors are completely grown that we detect any trace of the anchor-plate. This also makes its appearance as a straight needle lying beneath the middle of the shank; in the next stage it is forked at each end; these branches grow and divide again, until the plate is all sketched out, the margin being added last, and the whole becoming more solid (figs. 7-14). We have not met with any figure of the spicula of *S. digitata*, except the bad one given by Müller, whose work we have only been able to see in the Library of the Museum of Practical Geology.

2. SYNAPTA INHÆRENS (HOLOTHURIA), O.F. Müller. (Pl. XIV. figs. 18-22.)

The second European *Synapta* was discovered at Christiansand, on the coast of Norway, and figured and described in the 'Zoo-

logia Danica' (1781). The anchors and plates are also figured in the admirable Memoir of Duben and Koren*. The anatomy of this species is described at some length by M. Quatrefages †, who regarded it as a new species, and called it *S. Duvernœa*. These specimens were obtained on the coast of Britany, at the Isles Chaussey near St. Malo, where they were very abundant in the mud near low water, and attained a length of 10 to 18 inches, with a diameter of 5 to 12 lines.

The anchor-plates of this species (fig. 19) more nearly resemble those of the Red Sea *S. vittata* than the last. They are oval, with no arch or process at the articular end, and the disk is perforated by six oval cells surrounding a central opening each with a scalloped border, as in *S. vittata*.

The anchors have serrated flukes, the serrations varying from 3 to 7; and the anchors are sometimes shorter than the plates, sometimes considerably longer (figs. 18, 21).

The miliary granules are few, and confined to the muscular bands; they are only half as long as in *S. digitata*, and rudely crescent-shaped (fig. 20).

A specimen of this *Synapta* was obtained by Mr. Henslow at Aberystwith, and communicated in 1819 to Dr. Leach, who labelled it "*Jemania Henslowana*." It is a small individual with imperfectly developed spicula, but showing the characteristic pinnate tentacles.

In June 1856 Mr. J. W. Wilton, of Gloucester, found another example at Criccieth, on the same coast of Cardigan Bay. It was discovered under a stone, at low water, and presented the appearance of "a clear pinkish waving worm, about 3 inches long, with a number of little papillæ all over it, and five faint longitudinal bands from head to tail. It had twelve tentacles, with five digits on each side. It was perpetually waving and swelling in one part, contracting in another ‡. It lived but a short time, and finally constricted itself and broke up into half a dozen fragments."

In February 1856 Mr. E. C. Buckland obtained a finer specimen under similar circumstances, in Lihou Bay, Guernsey. A microscopic preparation of the skin of this specimen shows 150 anchors in the field of the inch object-glass ($\frac{1}{7}$ inch diameter); and the anchors are more than half as long again as the plates §.

Mr. Cocks, who met with *Synapta inhærens* on the coast of Cornwall, regarded it as a variety of *S. digitata*. He describes it as having "13 digitated pinnæ on each tentaculum. Length of specimens procured from 1 to $2\frac{1}{2}$ inches by $\frac{1}{16}$ th to $\frac{1}{8}$ th of an inch. Found in hard and stony soil; Helford, scarce; Falmouth, very rare. I have kept them alive for months in sea-water procured from Helford

* Proceedings of the Royal Academy of Sciences, Stockholm, 1846.

† Annales des Sciences Nat. 2 sér. t. 17. Zool. p. 19.

‡ Forskål named one species *Synapta reciprocans*, on account of these remarkable muscular movements.

§ "Slides" of this specimen are in many cabinets, with a red label, but with no specific name or locality.

or Gwyllyn-vase, but they invariably broke into fragments as soon as water from Green Bank was thrown into the glass."

Lastly, two small specimens were dredged by Mr. MacAndrew in Bantry Bay, in August 1857.

SYNAPTA BIDENTATA, W. & B. (Pl. XIV. figs. 23-25.)

The new species which we have now to describe was presented to the Zoological Museum of the Cambridge University by the Rev. G. Vachell, who brought it from China. There is also a specimen in the British Museum presented by Mr. Reeve. In its contracted state it measures only 2 inches in length and 5 lines in diameter. The skin is unusually thick, much corrugated transversely, and thrown into five deep longitudinal folds. It is almost devoid of colour, but the ventral band may be distinguished by its breadth, the lateral being rather less wide, and the dorsal muscles narrower still. The twelve tentacles are each furnished with four lobed digits surrounded with a sheath.

The anchors are short and stout (rather shorter than those of *S. digitata*), with straight projecting "beams"; the flukes are smooth and bifid. From 50 to 70 occur within a radius of $\frac{1}{14}$ th of an inch (fig. 23).

The anchor-plates are obovate, truncated at the articular end, and pierced by very numerous circular holes, which diminish in size from the centre to the circumference. The margin is never completed (so far as we have seen), but the boundary of the external perforations is broken, like that of a wire-gauge (fig. 24).

The miliary granules are rather large, very numerous, and resemble cruciform fragments of the anchor-plates. Near the bases of the tentacles, they become still more numerous, larger, and more complicated (fig. 25).

Monstrosities.—As might be expected of minute organs indefinitely multiplied, monstrosities are not unfrequent. Mr. Hislop has a slide of *Synapta vittata* in which two of the anchors have double shanks, and we have seen *S. bidentata* with three flukes.

Genus CHIRIDOTA, Esch. Fig. 26.

This genus was proposed by Eschscholtz at the same time with *Synapta*. It was defined as having *digitate* tentacles, whilst *Synapta* had *pinnate* tentacles,—an unfortunate definition, as all the species figured in the 'Zool. Atlas' are represented with *pinnate* tentacles; and of the two other examples of *Chiridota* quoted, viz. *Holothuria inhærens* and *H. lævis*, the first is a *Synapta* according to the author's own definition. It was on this account that Prof. Forbes referred our *digitate* species to *Chiridota*.

However, subsequent authors have agreed to apply the name *Synapta* to the species with anchors, which consequently adhere to the finger *; and to call those *Chiridota* which are ornamented with

* The name *Fistularia*, given by Forskal, has been abandoned, partly because the author included under it some true *Holothurie*, and chiefly because Lamarck employed it for these latter instead of the *Synaptæ*.

microscopic wheels. In *C. lævis* these wheels are very minute and clustered in little groups beneath the epidermis, and when the surface is raised with a needle point they are set free. In *Chiridota violacea*, figured by Müller in the Berlin Transactions, and again in Dr. Carpenter's 'Microscope,' the wheels are attached to a common connecting thread.

Prof. Steenstrup has formed a genus (or subgenus) for another Greenland species—*Myriotrochus Rinkii* (figs. 27-31), in which the wheels are larger and scattered over the skin, each having its own stalk. These wheels first appear as little stars, with rays or spokes of various number (18 to 25), which increase until they attain their normal length, and then expand at their ends until they join and form a rim (or *tire*) to the wheel. A ring of spines is afterwards formed on the thickened margin; the spines are pointed towards the centre of the wheel, and are as numerous as, or rather more numerous than, the spokes. As the wheels only occur on the three dorsal inter-muscular bands, they can scarcely assist in locomotion, and must be regarded as ornamental characteristics, such as nature loves to bestow for us to marvel at.

SYNAPTA, Eschscholtz, 1829.

1. *S. vittata* (*Fistularia*), Forskål, 1775. Suez, Red Sea.
2. *S. reciprocans*, Forsk. Suez, Red Sea.
3. *S. inhærens* (*Holothuria*), O. F. Müller, 1781 (= *Holothuria flava*, Rathke; *Jemania Henslowana*, Leach; *Synapta Duvernæa*, Quatr.). Christiansand og Kragerøe; Aberystwith and Criccieth, North Wales (*Henslow and Wilton*); Falmouth, Cornwall (*W. P. Cocks*); Bantry, W. Ireland (*MacAndrew and Barrett*); Guernsey (*E. C. Buckland*); Iles Chaussey, near St Malo (*Quatrefages*).
4. *S. digitata* (*Holothuria*), Montagu. Devonshire (*Mont., Cranch, Alder, Kingsley*); Falmouth (*Mr. Cocks*); W. Ireland (*Mr. Barlee*); Rothesay, Bute (*Mr. Alder*); Vigo Bay, N. Spain (*Mac Andrew*); Trieste (*Joh. Müller, Dr. Hartmann*).
5. *S. mamillosa*, Esch. Tahiti.
6. *S. maculata*, Chamisso & Eysenh., Act. Nat. Cur. x. p. 1. t. 25.
7. *S. ? verrucosa* (*Chiridota*), Esch. Sitcha, Russian America.
8. *S. Beselii*, Jäger, 1833. Celebes. Berlin Trans. t. 6. f. 15.
9. *S. radiosa*, Reynaud (teste Jäger). Coromandel.
10. *S. bidentata*, W. & B. 1858. China.
11. *S. lappa*, Müll. Berlin Trans. 1854, t. 6. f. 16. W. Indies.
12. *S. serpentina*, Müll. Id. f. 17. Celebes.

CHIRIDOTA, Esch.

1. *C. lævis* (*Holothuria*), O. Fabr. Greenland.
2. *C. violacea*, Peters. Mozambique.
3. *C. ? purpurea*, Less. Falkland Islands.
4. *C. lumbricus*, Esch. I. Radak, Coral Sea.
5. *C. discolor*, Esch. Sitcha, Russian America.

MYRIOTROCHUS, Steenstrup.

1. *M. Rinkii*, Stp. Greenland.

EXPLANATION OF PLATE XIV.

- Figs. 1-17. Spicula of *Synapta digitata*, Mont., magnified 125 diameters.
 Figs. 1-16. Anchors in various stages of growth.
 Figs. 7-14. Anchor-plates in various stages of growth.
 Fig. 15. Dwarf anchor and plate, close to fig. 16.
 Fig. 16. One of the larger anchors.
 Fig. 17. Miliary plates from one of the muscular bands.
- Figs. 18-22. Spicula of *Synapta inhærens*, Müll., magnified 125 times.
 Fig. 18. Long anchor and plate, from the Guernsey specimen.
 Fig. 19. Anchor-plate more fully formed, from the Guernsey specimen.
 Fig. 20. Miliary plates, from Bantry specimen.
 Fig. 21. Anchor and unfinished plate, from Bantry specimen.
 Fig. 22. Anchor and plate in use, seen obliquely.
- Figs. 23-25. Spicula of *Synapta bidentata*, W. & B., magnified 125 times.
 Fig. 23. Anchor of Chinese *Synapta*.
 Fig. 24. Anchor-plate; the anchor thrown out of focus.
 Fig. 25. Miliary plates; the more complex from near the head.
- Fig. 26. One of the wheels of *Chiridota lævis*, O. Fabr., Greenland, magnified 160 diameters.
- Figs. 27-31. Wheels of *Myriotrochus Rinkii*, Stp., Greenland, magnified 100 diameters.
 Figs. 27, 28. Young wheels, with unfinished spokes.
 Fig. 29. Wheel with the spokes full-grown and expanded at the ends.
 Fig. 30. Wheel with the spines beginning to appear on the tire.
 Fig. 31. Finished wheel of rather unusual size.